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ABSTRACT

The purpose of this study was to discover what teachers believe about problem solving in mathematics and to what extent their beliefs are reflected in the beliefs of students. Ten 5th-grade teachers in a large rural school district volunteered to participate. Each teacher identified one student perceived as successful and one perceived as unsuccessful in problem solving in mathematics. Interviews were conducted with teachers and their students. Interview questions were designed to elicit beliefs about the nature of mathematical problem solving, attributions about the causes of students' performance in problem solving, and beliefs about the teaching and learning of problem solving in mathematics. Major conclusions were: (1) students and teachers believe that problem solving is primarily an application of computational skills; (2) students and teachers reported that their judgments about successful problem solving were based on right answers; (3) students' and teachers' attributions about the causes of success and failure affect learning in problem solving; (4) teachers focused on right answers and strongly discouraged the use of calculators for problem solving; and (5) teachers tended to overestimate students' ability to do problems involving computation and underestimate students' ability to do reasoning problems. (YP)

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Fifth grade teachers and their students: An analysis of beliefs about mathematical problem solving.

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Purpose of the Study Over the past 30 years the development of problem solving ability in school mathematics has gained increased attention. Numerous research studies have been conducted to evaluate instruction in problem solving, yet many of these studies produced findings that were contradictory (Marcucci, 1980). In 1980, the National Council of Teachers of Mathematics (NCTM) put forth a recommendation that problem solving be the focus of school mathematics in the 1980's. Both educators and professional organizations have sought throughout the 1980's to improve the quality of problem solving instruction in elementary and secondary mathematics classrooms. Yet, eight years after the NCTM recommendation, student performance still remains poor as indicated by the results of the 1987 NAEP Test.

The purpose of this study was to discover what teachers believe about problem solving in mathematics and to what extent the beliefs of teachers are reflected in the beliefs of students in their classrooms. In particular, the study focused on three categories of beliefs that are apt to influence classroom instruction and impinge on student learning. These categories were the teachers' and students' beliefs about the nature of mathematical problem solving: attributions about the causes of students' performance in problem solving; and beliefs about the teaching and learning of problem solving in mathematics.

Theoretical Framework Grouws (1985) reported that we know little about the teachers' role in developing students' problem solving ability because most research on the teaching of problem solving has focused on students and how students solve problems. Although suggestions stemming from this research are important, there is a need to examine the teachers' role in the development of students' problem solving ability. The majority of students learn to solve problems in a whole-group classroom situation in which teachers exercise a substantial amount of influence. Teachers' work with students and their intervention in the learning process affect student learning in a significant way (Berliner & Tikunoff, 1976; Evertson, 1980).

This study of teacher beliefs is guided by a model of teacher thought and action proposed by Clark and Peterson (1985) asserting that the behavior of teachers is greatly influenced by their thought processes. Clark and Peterson suggested that, in general, teachers' beliefs about attributions for the causes of student behavior and the teachers' beliefs about teaching and learning affect the teachers' actions, which in turn, affect student behavior and achievement.

Studies in mathematics education (Thompson, 1982; Kuhs, 1980; and Shirk, 1972) indicate that teachers' beliefs about mathematics, about learning, and about teaching affected the way in which mathematics was taught. In most cases, research indicated that teachers' practices were consistent with their beliefs. Teachers' behavior was influenced by their beliefs and likewise influenced students' beliefs, behavior, and achievement.

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Description of the Sample Ten fifth grade teachers from four elementary schools in a large rural school district volunteered to participate in the study. The schools, located in two neighboring towns, are racially integrated and enroll students from all socioeconomic levels. Each teacher identified two students from his/her classroom to participate in the study, one student perceived by the teacher as successful and one perceived as unsuccessful in problem solving in mathematics. The ten teachers who volunteered to participate taught in self contained fifth grade classrooms. The number of years of classroom experience ranged from one to 29 years, and the number of years at the fifth grade level ranged from one to 19 years.

A total of 15 students identified by the teachers were male and 5 were female. Of the 10 students perceived by their teachers to be successful in problem solving, 7 were male and 3 were female. Of the 10 students perceived by their teachers to be unsuccessful in problem solving, 8 were male and 2 were female. Students' ages ranged from 10 to 12 years with a median age of 11 years. Three of the 20 students were 12 years old and all 3 were perceived as unsuccessful in problem solving by their teachers. Students were not told the basis on which they were chosen to participate in the study.

Methodology This is a qualitative study with interviewing as the primary method of data collection. The purpose of this study was to uncover teachers' beliefs about problem solving in mathematics and to determine the extent to which teachers' beliefs affect the beliefs of their students. For this reason, an interview guide based on the assumptions suggested by Patton (1982), was developed to elicit beliefs and perspective of teachers and students about problem solving.

Parallel interviews were conducted with teachers and their students. The interviews were guided by a standardized interview schedule which focused on experiences, beliefs, and practices related to the teaching and learning of problem solving as well as to attributions for the causes of students' performance in problem solving. During the interviews, a set of nine word problems selected from a report on the 1987 NAEP Tests (Kouba, et al., 1988) was presented to teachers and students. Each teacher was asked to predict whether or not the students he/she had identified to participate in the study would be able to solve each of the nine problems. Students were asked to solve each of the nine problems orally.

Interview questions designed to elicit beliefs about problem solving were organized a priori into three categories: 1) the nature of problem solving, 2) attributions for the causes of students' success and failure in problem solving, and 3) the teaching and learning of problem solving. The three categories provided the overall structure for the analysis of the interview data. Verbatim transcripts of the interviews were analyzed using strategies proposed by Miles and Huberman (1984) to reduce the complexity of the data.

The Pearson Product-Moment correlation coefficient was used to describe the extent to which teachers' predicted scores (TPS) were related to students' actual scores (SAS) on the set of nine problems.

Major Findings and Conclusions The analysis of interview data and teachers' predictions led to five general conclusions. First, fifth grade teachers believe that problem solving in mathematics is primarily an application of computational skills. Students' beliefs about the nature of mathematical problem solving are, for the most part, consistent with the beliefs held by the teachers. This conclusion is supported by the fact that when teachers and students were asked to define mathematical problem solving, the majority of them reported that problem solving was applying computational skills to everyday life. Teachers, however, focused on present everyday applications, while students referred only to future applications.

Second, students and teachers reported that their judgments about successful problem solving were based on right answers. None of the teachers or students used calculators for the solution of word problems or for anything in mathematics.

Third, students' and teachers' attributions about the causes of success and failure in problem solving affect learning in problem solving. Fifth grade teachers in the study basically attributed success and failure in problem solving to differences in student ability, citing computational ability, reading ability, and reasoning ability as causes for students' performance. The feelings of helplessness and frustration that teachers expressed about the teaching of problem solving are common to those who attribute performance to a stable cause, such as ability, and support their belief that ability was the cause of students' performance. Students attributed success and failure primarily to a combination of ability and effort. The focus of the successful students was primarily on effort, while unsuccessful students focused primarily on ability. Successful students reported that working hard, paying attention, listening, along with having good computational skills were reasons for success or failure. Unsuccessful students reported that being smart, paying attention, and knowing their basic facts were reasons for success and failure.

The fourth conclusion is focused on the beliefs of teachers and students about the teaching and learning of problem solving. The methods and materials that teachers used to teach problem solving do not appear to be different than those they use to teach other lessons in mathematics. The activities of problem solving in the fifth grade classrooms enhance, if anything, computational ability. This conclusion is supported by the fact that all teachers use the mathematics textbook as the primary source in both planning and teaching problem solving lessons. Teachers focused on right answers and strongly discouraged the use of calculators for problem solving. Use of calculators was strongly rejected by students as well. The focus on right answers inhibits the students' ability to focus on the process of problem solving.

Finally, teachers tended to overestimate students' ability to do problems involving computation and underestimate students' ability to do reasoning problems. The teachers' predictions are perhaps a function of the overemphasis on the computational aspects of problem solving and gross underrepresentation of reasoning problems in fifth grade classroom instruction. This conclusion was supported by the fact that the correlations describing the relationship between teachers' predictions and students' actual performance were moderate. A closer examination of the teachers' predications and students' actual performance revealed that teachers more accurately predicted students' success on problems involving a calculation than they did the success on reasoning problems, especially when predicting the performance of unsuccessful students.

The teachers believed that many of their students could not solve the reasoning problems. This is an important statement about the kinds of opportunities that students have for learning problem solving. When the teachers' predicted the unsuccessful students' performance on the reasoning problems, they predicted failure, when indeed most of the students were successful on these problems. We might assume that students are not given the opportunity to develop ability to solve reasoning problems and have a reduced opportunity to learn because of the teachers' beliefs about their ability.

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